Three-phase Asymmetry and Phase-sequence Phase-loss Relay

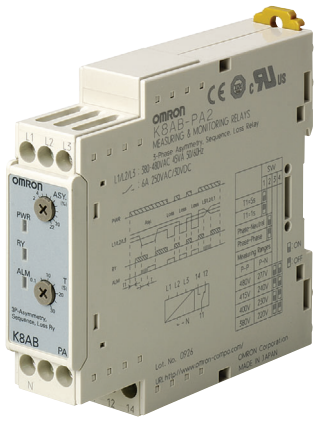
K8AB-PA

CSM_K8AB-PA_DS_E_2_1

Ideal for 3-phase voltage asymmetry monitoring for industrial facilities and equipment.

- Monitor voltage asymmetry, phase sequence, and phase loss for three-phase 3-wire or 4-wire power supplies with just one Unit.
  Switch setting for 3-phase 3-wire or 3-phase 4-wire power supply.
- One SPDT output relay, 6 A at 250 VAC (resistive load).
- World-wide power specifications supported by one Unit (switchable).
- Relay status can be monitored using LED indicator.

⚠ Refer to *Safety Precautions for the K8AB Series*. Refer to page 9 for the Q&A section.



Model Number Structure

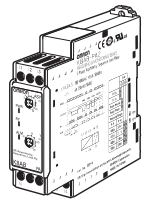
■ Model Number Legend

K8AB-□□
1 2 3

1. **Basic Model**
   K8AB: Measuring and Monitoring Relays
2. **Functions**
   PA: Three-phase Asymmetry and Phase-sequence Phase-loss Relay.
3. **Rated Input Voltage**
   1: AC 115, 127, 133, 138, 200, 220, 230, 240
   2: AC 220, 230, 240, 277, 380, 400, 415, 480

Ordering Information

■ List of Models

Three-phase Asymmetry and Phase-sequence Phase-loss Relay	Rated input (See note 2.)		Model
	3-phase 3-wire mode	AC 200, 220, 230, 240	**K8AB-PA1**
	3-phase 4-wire mode	AC 115, 127, 133, 138	
	3-phase 3-wire mode	AC 380, 400, 415, 480	**K8AB-PA2**
	3-phase 4-wire mode	AC 220, 230, 240, 277	

Note: 1. Three-phase, three-wire or four-wire and the input range are switched using a DIP switch.

2. The power supply voltage is the same as the rated input voltage.

Ratings and Specifications

■ Ratings

Rated input voltage	**K8AB-PA1**	Three-phase, three-wire Mode: 200, 220, 230 and 240 VAC Three-phase, four-wire Mode: 115, 127, 133 and 138 VAC
	K8AB-PA2	Three-phase, three-wire Mode: 380, 400, 415 and 480 VAC Three-phase, four-wire Mode: 220, 230, 240 and 277 VAC
Input load		K8AB-PA1: 25 VA max. K8AB-PA2: 45 VA max.
Operating value setting range (ASY.)		Asymmetry rate: 2% to 22%
Operating value		Asymmetry operating value = Rated input voltage × Asymmetry set value (%) The asymmetry operation will function when the potential difference between the highest and lowest voltage phases equals or exceeds the asymmetry operating value.
Reset value setting range (HYS.)		5% to 50% of operating value
Reset method		Automatic reset
Operating time setting range (T)	**Asymmetry**	0.1 to 30 s
	Reversed phase/phase loss	0.1 s max.
Startup lock time (LOCK)		1 s or 5 s (Switched using DIP switch.)
Indicators		Power (PWR): Green, Relay output (RY): Yellow, Alarm outputs (ALM): Red
Output relays		One SPDT relay (NC operation)
Output relay ratings		Rated load Resistive load 6 A at 250 VAC (cosϕ = 1) 6 A at 30 VDC (L/R = 0 ms) Inductive load 1 A at 250 VAC (cosϕ = 0.4) 1 A at 30 VDC (L/R = 7 ms) Maximum contact voltage: 250 VAC Maximum contact current: 6 A AC Maximum switching capacity: 1,500 VA Minimum load: 10 mA at 5 VDC Mechanical life: 10,000,000 operations Electrical life: Make: 50,000 times, Break: 30,000 times
Ambient operating temperature		−20 to 60°C (with no condensation or icing)
Storage temperature		−40 to 70°C (with no condensation or icing)
Ambient operating humidity		25% to 85% (with no condensation)
Storage humidity		25% to 85% (with no condensation)
Altitude		2,000 m max.
Terminal screw tightening torque		0.49 N·m
Terminal wiring method		Recommended wire Solid wire: 2.5 mm^2 Twisted wires: AWG16, AWG18 **Note: 1.** Ferrules with insulating sleeves must be used with twisted wires. **2.** Two wires can be twisted together. Recommended ferrules Al 1,5-8BK (for AWG16) manufactured by Phoenix Contact Al 1-8RD (for AWG18) manufactured by Phoenix Contact Al 0,75-8GY (for AWG18) manufactured by Phoenix Contact
Case color		Munsell 5Y8/1
Case material		ABS resin (self-extinguishing resin) UL94-V0
Weight		Approx. 120 g
Mounting		Mounted to DIN Track or via M4 screws (tightening torque: 1.2 N·m)
Dimensions		22.5 (W) × 90 (H) × 100 (D) mm

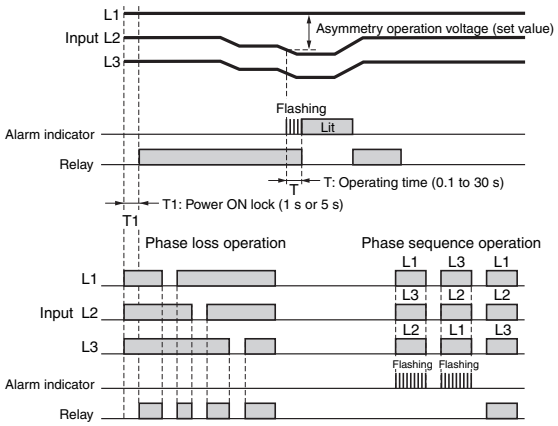
■ Specifications

Input frequency range		45 to 65 Hz
Overload capacity		Continuous input: 115% of maximum input, 10 s max.: 125% of maximum input
Setting error	**Operating value**	Set value ±10% full scale
	Operating time	
	Startup lock time	Set value ±0.5 s
Repeat error	**Operating value**	Operating value ±2% Error calculation: Error = ((Maximum operating value − Minimum operating value (over 10 operations))/2)/Average value × 100%
	Reset value	Operating value × 95% ±2% Error calculation: Error = ((Maximum reset value − Minimum reset value (over 10 resets))/2)/Average value × 100%
	Operating time	Operating time repeat error: ±50 ms Asymmetry: Measured when the input suddenly changes from the three-phase asymmetry status to a difference between the maximum and minimum phases of 120% of the asymmetry operating value.
	Startup lock time	Startup lock time repeat error: ±0.5 s (The operating time when the operating time is set to the minimum value and the power supply suddenly changes from 0% to 100%.)
Temperature influence		Operating value Drift based on measured value at standard temperature: −20°C to standard temperature: ±1,000 ppm/°C max. Standard temperature to 60°C: ±1,000 ppm/°C max. (Humidity: 25% to 80%) Operating time Fluctuation based on measured value at standard temperature: −20°C to standard temperature: ±10% max. Standard temperature to 60°C: ±10% max. (Humidity: 25% to 80%)
Humidity influence		Operating value Based on ambient humidity of 65% 25% to 80%: ±5% max. Operating time Based on ambient room humidity 25% to 80%: ±10% max.
Influence of input frequency		At 45 to 65 Hz Operating value ±5% max. Operating time ±10% max. **Note:** The error in the operating value and operating time under standard conditions.
Applicable standards	**Conforming standards**	EN60255-5 and EN60255-6 Installation environment (Pollution Degree 2, Overvoltage Category III)
	EMC	EN61326
	Safety standards	UL508
Insulation resistance		20 MΩ min. Between external terminals and case Between input terminals and output terminals
Dielectric strength		2,000 VAC for one minute Between external terminals and case Between input terminals and output terminals
Noise immunity		1,500 V power supply terminal common/normal mode Square-wave noise of ±1 μs/100 ns pulse width with 1-ns rise time
Vibration resistance		Frequency 10 to 55 Hz, 0.35-mm single amplitude, acceleration 50 m/s^2 10 sweeps of 5 min each in X, Y, and Z directions
Shock resistance		100 m/s^2, 3 times each in 6 directions along three axes (up/down, left/right, forward/backward)
Degree of protection		Terminal section: Finger protection

Connections

■ Wiring Diagram

Voltage Asymmetry and Phase Sequence/Phase Loss Operation Diagram



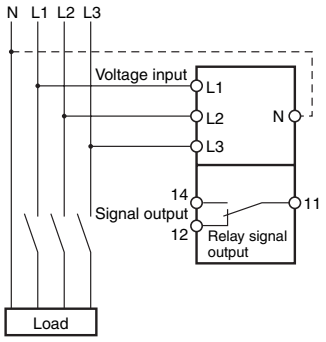
Note: 1. K8AB-PA output relay is normally operative.
2. The power ON lock prevents unnecessary alarms from being generated during the instable period when the power is first turned on. There is no relay output during timer operation.
3. Phase loss is detected by L1, L2, and L3 voltage drops.
A phase loss will exist if any of the phases drops below 60% of the rated input.
4. L1 and L2 function both as the power supply terminals and as input terminals.
If the voltage drops dramatically, then the Relay will not operate due to an undervoltage.
5. Motor load phase loss cannot be detected during operation.
6. Phase loss is detected based on voltage, so phase loss cannot be detected on the load side.

Calculating the Asymmetry Operating Voltage

Asymmetry operation condition = (Highest voltage − Lowest voltage) > Asymmetry operating voltage

Asymmetry operating voltage = Rated input voltage (V) × Asymmetry set value (%)

Note: The rated input voltage is selected and set with the DIP switch.



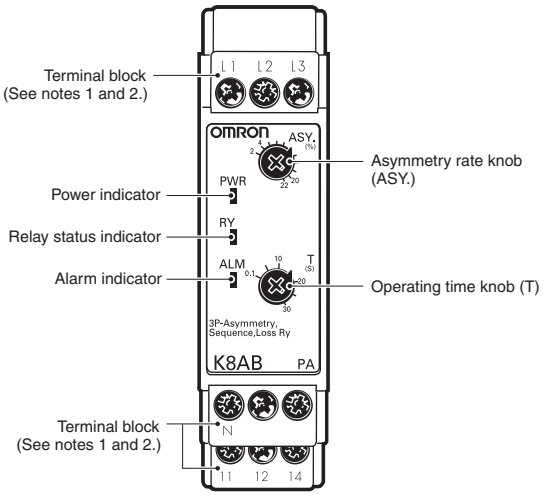
Operation Indicators

Item	Display		Contact operation
	Ry_LED	Alarm_LED	Alarm_LED
Asymmetry	OFF	ON	OFF
Phase loss	OFF	ON	OFF
Reversed phase	OFF	Flashing (See note.)	OFF
Correct phase	ON	OFF	ON

Note: The indicator will flash once per second after a phase loss is detected and once per 0.5 second during the detection time.

Nomenclature

■ Front



Indicators

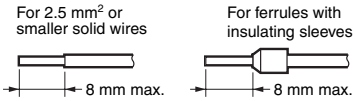
Item	Meaning
Power indicator (PWR: Green)	Lit when power is being supplied (see note).
Relay status indicator (RY: Yellow)	Lit when relay is operating (normally lit).
Alarm indicator (ALM: Red)	Asymmetry voltage error indicator The indicator flashes to indicate the error status after the input has exceeded the threshold value while the operating time is being clocked.

Note: The input across L1 and L2 is used for the internal power supply. Therefore, the power indicator will not be lit if there is no input across L1 and L2.

Setting Knobs

Item	Usage
Asymmetry rate knob (ASY.)	Used to set the asymmetry rate to 2% to 22%.
Operating time knob (T)	Used to set the operating time to 0.1 to 30 s.

Note: 1. Use either a solid wire of 2.5 mm^2 maximum or a ferrule with insulating sleeve for the terminal connection.
The length of the exposed current-carrying part inserted into the terminal must be 8 mm or less to maintain dielectric strength after connection.



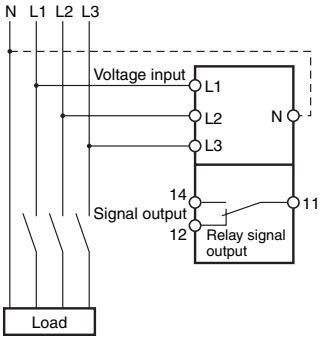
Recommended ferrules
Phoenix Contact
- Al 1,5-8BK (for AWG16)
- Al 1-8RD (for AWG18)
- Al 0,75-8GY (for AWG18)

2. Tightening torque
Recommended: 0.49 N·m
Maximum: 0.54 N·m

■ Operation and Setting Methods

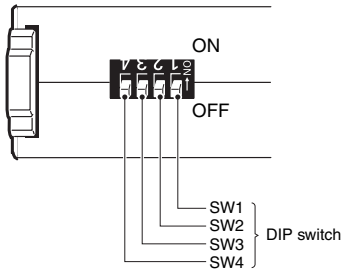
Connections

1. Input
   Connect to L1, L2, and L3 (for three-phase three-wire mode) or L1, L2, L3, and N (for three-phase four-wire mode), depending on the mode selected using pin 2 on the DIP switch.
   The Unit will not operate correctly if the DIP switch setting and the wiring do not agree.
   Make sure the phase sequence is wired correctly. The Unit will not operate normally if the phase sequence is incorrect.
2. Outputs
   Terminals 11, 12, and 14 are output terminals for SPDT.



DIP Switch Settings

The power ON lock time, number of wires, and rated voltage are set using the DIP switch located on the bottom of the Unit.



DIP Switch Functions

K8AB-PA1

SWITCH	ON ● ↑ / OFF ❍ ↓		4 (ON / OFF)	3	2	1
Power ON lock time	5 s		---	---	---	●
	1 s		---	---	---	❍
Number of wires	Three-phase, four-wire		---	---	●	---
	Three-phase, three-wire		---	---	❍	---
Rated voltage	Three-phase, three-wire	Three-phase, four-wire				
	240 V	138 V	●	●	---	---
	230 V	133 V	●	❍	---	---
	220 V	127 V	❍	●	---	---
	200 V	115 V	❍	---	---	---

Note: All pins are set to OFF at the factory.

K8AB-PA2

SWITCH	ON ● ↑ / OFF ❍ ↓		4 (ON / OFF)	3	2	1
Power ON lock time	5 s		---	---	---	●
	1 s		---	---	---	❍
Number of wires	Three-phase, four-wire		---	---	●	---
	Three-phase, three-wire		---	---	❍	---
Rated voltage	Three-phase, three-wire	Three-phase, four-wire				
	480 V	277 V	●	●	---	---
	415 V	240 V	●	❍	---	---
	400 V	230 V	❍	●	---	---
	380 V	220 V	❍	❍	---	---

Note: All pins are set to OFF at the factory.

Setting Method

1. Asymmetry
Asymmetry is set using the asymmetry operation knob (ASY.)
The setting can be between 2% and 22% of the rated input.
Turn the knob while there is an input to the input terminals until the alarm indicator flashes (when the set value and the input have reached the same level.)
Use this as a guide to set the asymmetry.
The rated input depends on the model and DIP switch setting.

Example: K8AB-PA1 with Pin 2 Turned OFF (Three-phase, Three-wire Mode) and Pins 3 and 4 Turned OFF (Rated Voltage of 200 V)
The rated input voltage is 200 VAC and the setting range is 4 to 44 V.
If the setting (ASY. knob) is at 10%, the asymmetry operation voltage is 20 V and an alarm will be output if the difference between the minimum and maximum phases for two of the three phases exceeds 20 V.

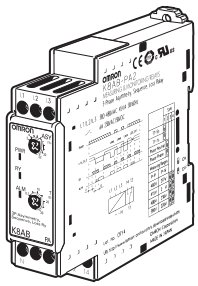
2. Operating Time
The operating time is set using the operating time knob (T).
The operating time can be set to between 0.1 and 30 s.
Turn the knob while there is an input to the input terminals until the alarm indicator flashes (when the set value and the input have reached the same level.)
Use this as a guide to set the operating time.
If the input exceeds the asymmetry set value, the alarm indicator will start flashing for the set period and then stay lit.

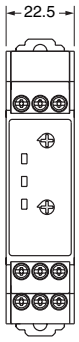
Dimensions

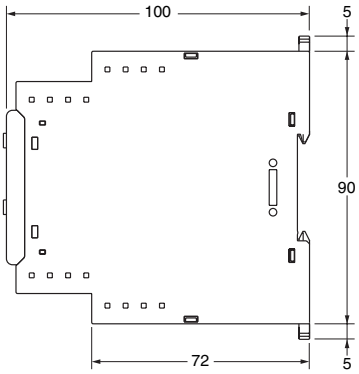
(Unit: mm)

Three-phase Asymmetry and Phase-sequence Phase-loss Relay

K8AB-PA1
K8AB-PA2







Questions and Answers

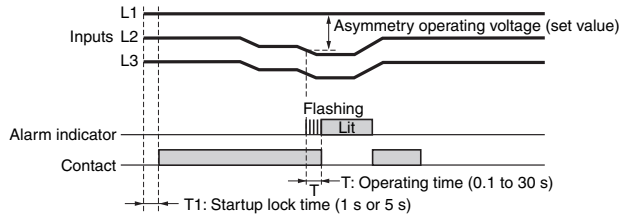
Q **Checking Operation**

A With the rated input voltage applied, gradually change the voltage to any one phase. The Unit will operate when the difference between the maximum and minimum voltage phases reaches or exceeds the asymmetry operating value.

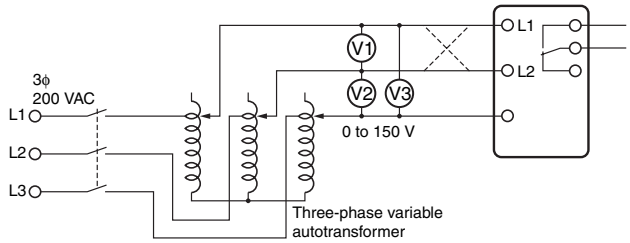
Asymmetry operating value = Rated input voltage × Asymmetry set value (%)

Example: For monitoring mode set to three-phase three-wire monitoring, a rated voltage of 200 V, and an operating time of 5 s.

Note: K8AB-PA□ output relays are normally operative.



Connection Diagram 1



Q **How to Measure the Operating Time**

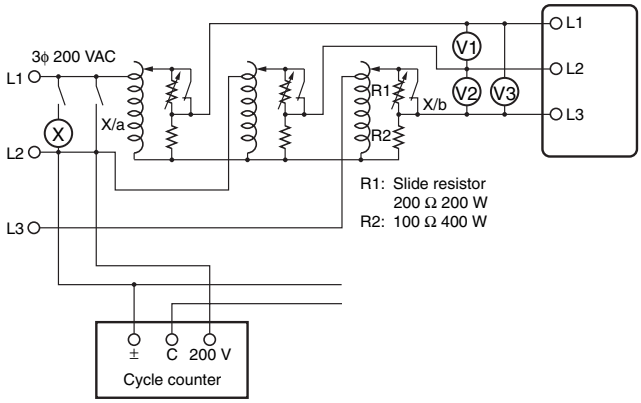
A Asymmetry

Change the input rapidly from a symmetric state to an asymmetric state and measure the time until the relay operates.

Operating Time

Adjust the slide resistor so that the voltage difference applied to the K8AB terminals is equal to or greater than the asymmetry operating value when the auxiliary relay operates, as shown in connection diagram 2. Close the switch and use the cycle counter to measure the operating time.

Connection Diagram 2



Q **Checking the Phase Sequence and Phase Loss Operation**

A Phase Sequence Operation

Switch the wiring, as shown by the dotted lines in connection diagram 1, to reverse the phase sequence and check that the K8AB operates.

Phase Loss Operation

Create a phase loss for any input phase and check that the K8AB operates.

Q **Operating Adjustment Knobs**

A Use a screwdriver to turn the knobs. There is a stopper to prevent the knob from turning any further once it has been turned completely to the left or right. Do not force the knob past these limits.

Q **Load-side Phase Loss**

A In principle, phase loss cannot be detected on the load side because the K8AB-PA□ measures three-phase voltage to determine phase loss.

Q **Motor Load Phase Loss during Operation**

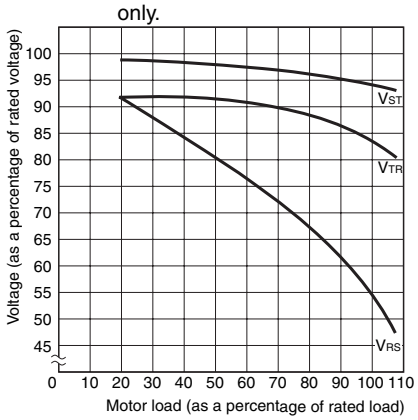
A Phase loss cannot be detected for motor loads during operation. Use the asymmetry detection function.

Normally, three-phase motors will continue to rotate even if one phase is open. The three-phase voltage will be induced at the motor terminals. The diagram shows voltage induction at the motor terminals when phase R is lost with a load applied to a three-phase motor. The horizontal axis shows the motor load as a percentage of the rated load, and the vertical axis shows voltage as a percentage of the rated voltage. The lines in the graph show the voltage induced at the motor terminals for each load when phase loss occurs during operation. As the graph shows, phase loss cannot be detected because the motor terminal voltage does not drop very much even if a phase is lost when the load on the motor is light. Use the asymmetry detection function to detect asymmetry in the motor terminal voltages.

Set the operating time carefully because it will affect the time from when the phase loss occurs until tripping when this function is used.

Characteristic Curve Diagram

Note: This characteristic curve shows the approximate values only.



Note: For phase loss of phase R. V_{ST}, V_{TR}, and V_{RS} indicate the motor terminal voltage at phase loss.

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.

To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

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